NASA Technology Transfer and Commercialization Update

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NASA Headquarters

NAC Technology and Innovation Committee Meeting
Kennedy Space Center

January 12, 2011

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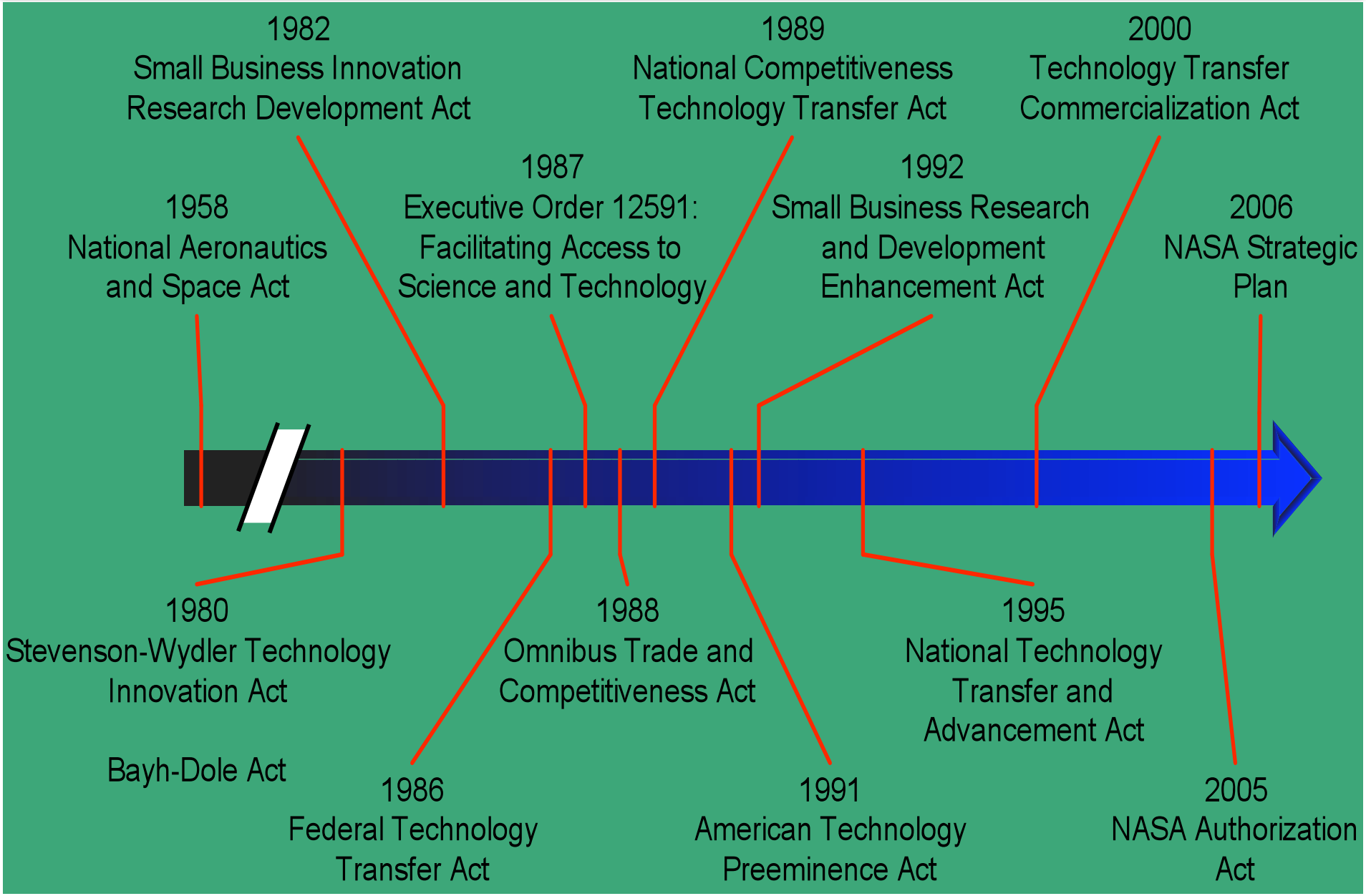
Policy Guidance and Statutory Authority



National Aeronautics and Space Act

- Section 102 (42 U.S.C. 2451) requires NASA to conduct its activities to contribute to U.S. preservation as leader in aeronautical and space S&T; Original mandate for NASA to transfer valuable technology for benefit of US Industry.
- Section 305 (42 U.S.C. 2457) authorizes NASA to protect inventions to which it has title, provided original NASA licensing authority (deleted upon passage of Bayh-Dole).
  - Applies to large business contracts, grants, & cooperative agreements; Large businesses must reports inventions.
  - Government owns inventions developed under these contracts.
  - Administrator may waive NASA's rights.
    - Large businesses must commercialize.
    - NASA obtains license on behalf of Government.
- Section 203 (42 U.S.C. 2473) requires NASA to provide widest practicable and appropriate dissemination of information concerning its activities and their results.
- NASA must monitor and enforce compliance with Space Act to protect the Government's interests and protect the public's investment.

Government-Wide Legislation – Since 1980

- Demonstrated commitment to technology transfer.
  - Fostering public availability of federally funded technology.
  - Transfer of technology from Federal laboratories to the private sector.
- Stevenson-Wydler and FTTA: Continuing series of laws to define and promote technology transfer (15 U.S.C. Ch 63).
  - Encouraged development of commercial technologies through collaboration among Federal labs, academia, and industry.
    - Technology transfer mechanisms and incentives.
    - Joint research & development projects.
    - Personnel exchange.
  - Transfer of federally owned or originated technology is a national policy and a mission of each federal laboratory.
  - Federal agencies that operate/direct federal laboratories must have a formal Technology Transfer program.
  - Federal laboratories must fund technology transfer activities.
  - Established the Federal Laboratory Consortium for Technology Transfer.

Bayh-Dole Act

- Bayh-Dole Act (35 U.S.C. Ch 18) established that agencies should:
  - Encourage maximum participation of industry in federally supported R&D;
  - Use patent system to promote transfer and public availability of federally funded inventions; and
  - Ensure Government obtains sufficient rights.
- Small entities may retain title to inventions developed under federal funding agreements.
  - Small businesses, universities and non-profit organizations.
  - Contracts, grants, cooperative agreements & subcontracts.
- Government-wide authority to license government owned inventions.
- Applies to small entity contracts, grants and cooperative agreements.
- Agencies must establish Government's rights in inventions.
  - If small entity elects to retain title:
    - Must commercialize invention;
    - Government obtains license.
  - If title not retained, Government may obtain title.

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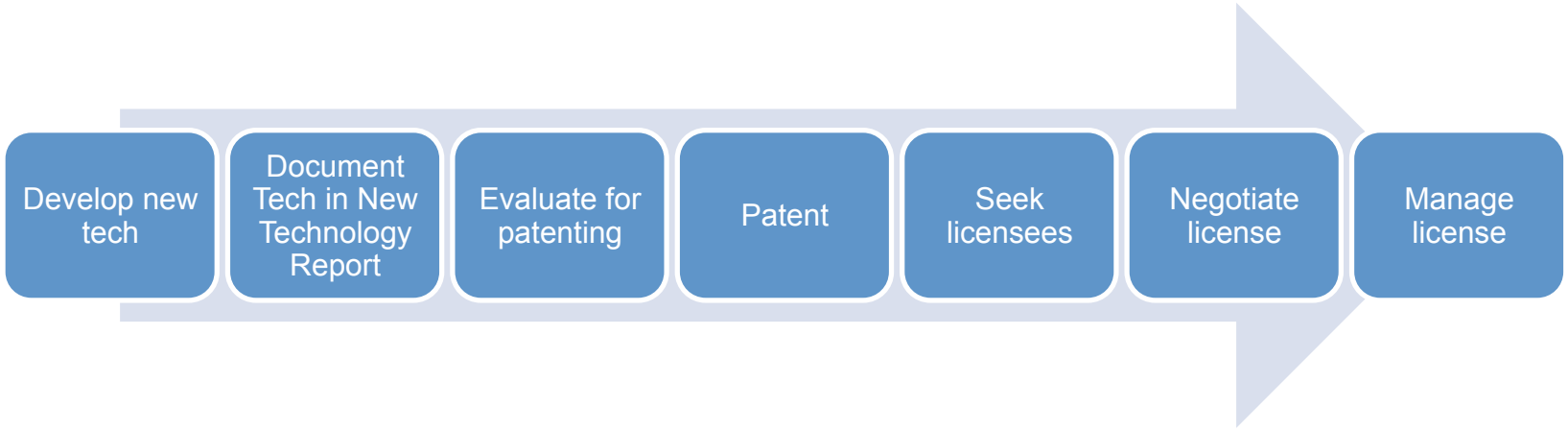
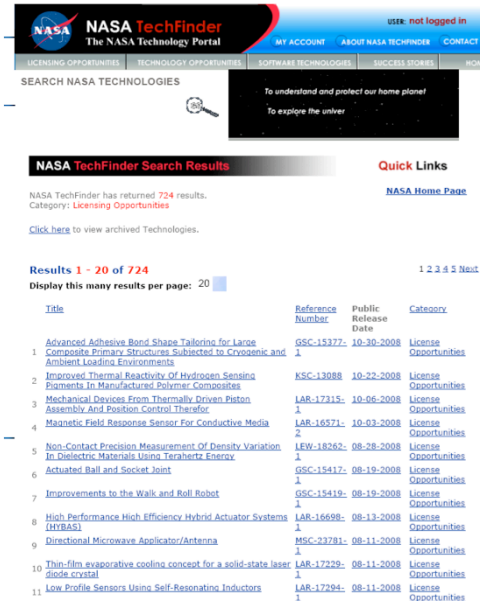
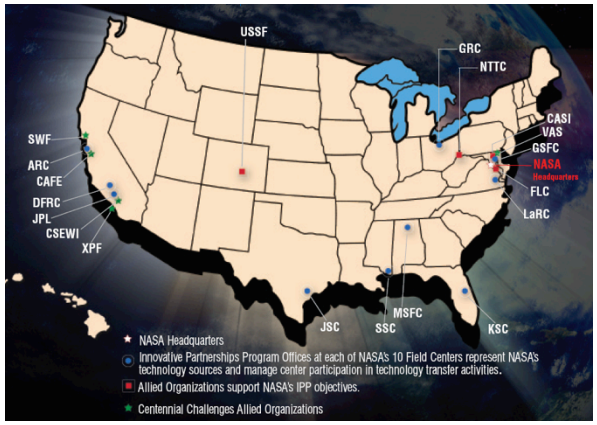
Intellectual Property Management



- OCT manages NASA's Intellectual Property via PICS and the Technology Partnership offices at each of the Centers.
- Large inventory of reported inventions and new technologies available for transfer to industry, academia and the public sector.
- Patent application filing (in conjunction with Patent Counsel).
- Seek licensees through marketing of available technologies and identification of potential partners – meetings, publications, online, etc.
  - Participation in Ocean Tomo IP Auction is a recent innovation.
- Licensing of patents and copyrights for transfer of technology to private sector (in conjunction with Patent Counsel).
- Collection of royalties by Centers and reinvestment of funds back into research and technology programs.

Some Tools Used by NASA





Tech Briefs

- Monthly publication on NASA technologies available for transfer.
- Reaches over 700,000 technologists across all industries.

TechFinder

- Online database of technologies available for transfer.
- Field Centers have specific information on technologies available at their center.

OCT Network

- Technology Transfer Professionals at all ten NASA Field Centers.
- Allied organizations to assist NASA.

Contents

NASA Inventions, Patents and Licenses

NASA R&D

New Technology Reports (NTRs) • 1,373 in FY 2009

Patented Technology • 114 issued in FY 2009

Patent Licenses • 67 new in FY09, 504 active

New/Improved Products/Services

IP Summary Data

- From NASA input to the Federal Laboratory Technology Transfer Summary Report to the President and Congress

Table 1: Collaborative Relationships for Research and Development

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
NASA	● **CRADAs**, total active in the FY	1	1	1	1	1
	- New, executed in the FY	1	0	0	1	0
	▪ Traditional CRADAs, total active in the FY	1	1	1	1	1
	▪ Non-traditional CRADAs, total active in FY	0	0	0	0	0
	▪ Other collaborative R&D relationships	4,038	3,509	2,887	2,750	2,743
	--Space Act Agreements, Sofware Use Agreements, etc.					

Table 2: Invention Disclosure and Patenting

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
NASA	● New inventions disclosed in the FY	1,682	1,713	1,487	1,297	1,373
	● Patent applications filed in the FY	209	219	193	166	128
	● Patents issued in the FY	139	146	108	135	114

IP Summary Data

Table 3: Profile of Active Licenses

		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
NASA	• **All licenses**, number total active in the FY	1,340	1,680	2,035	2,337	2,497
	▫ New, executed in the FY	506	375	413	347	418
	▪ **Invention licenses**, total active in the FY	443	482	474	486	504
	▫ New, executed in the FY	130	73	43	50	67
	▪ **Other IP licenses**, total active in the FY	897	1,198	1,561	1,851	1993
	▫ New, executed in the FY	376	302	370	297	351

Table 4: Characteristics of Licensing Bearing Income

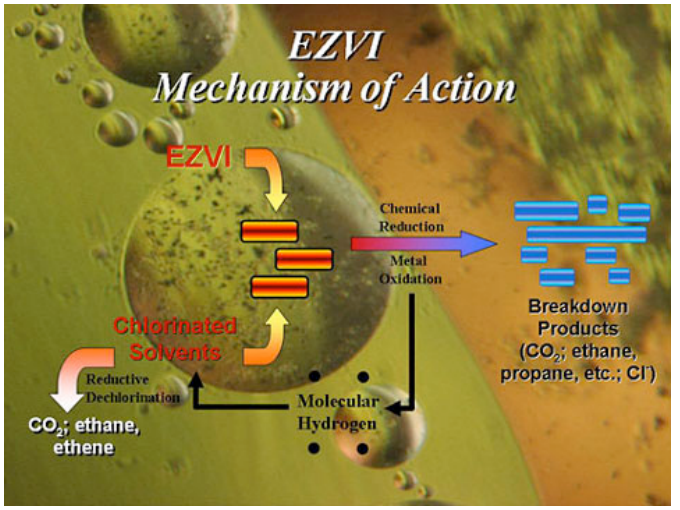
		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
NASA	• **All income bearing licenses**, number	238	251	253	265	263
	▫ Exclusive	105	110	113	119	119

Table 5: Income from Licensing (Dollars reported in thousands)

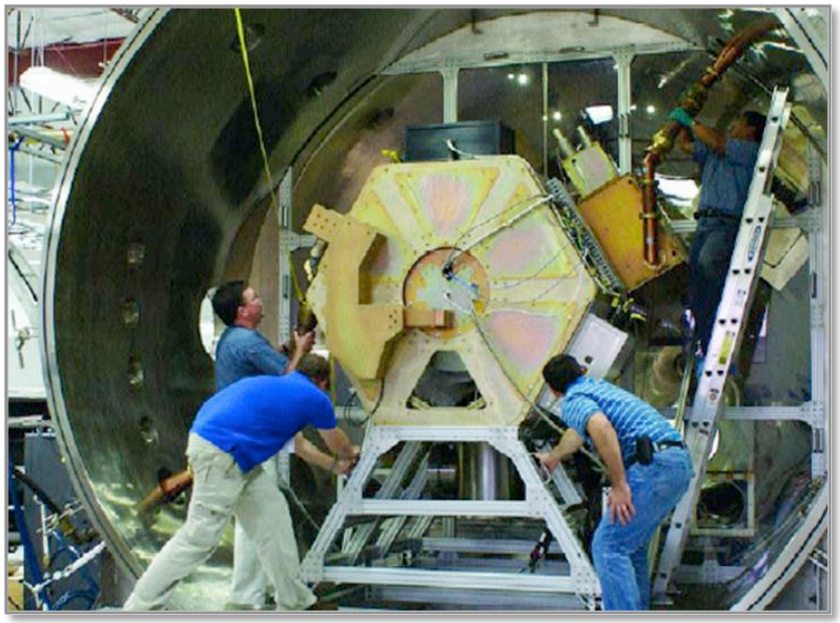
		FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
NASA	• **Total income**, all licenses active in FY	$3,930	$4,862	$3,689	$4,223	$2,388
	▪ **Invention licenses**	$3,930	$4,726	$3,689	$4,183	$2,374
	▪ **Other IP licenses**, total active in the FY	n/a	$136	n/a	$40	$14
	• **Total Earned Royalty Income**, (ERI)	$1,331	$2,178	$1,520	$1,711	$719

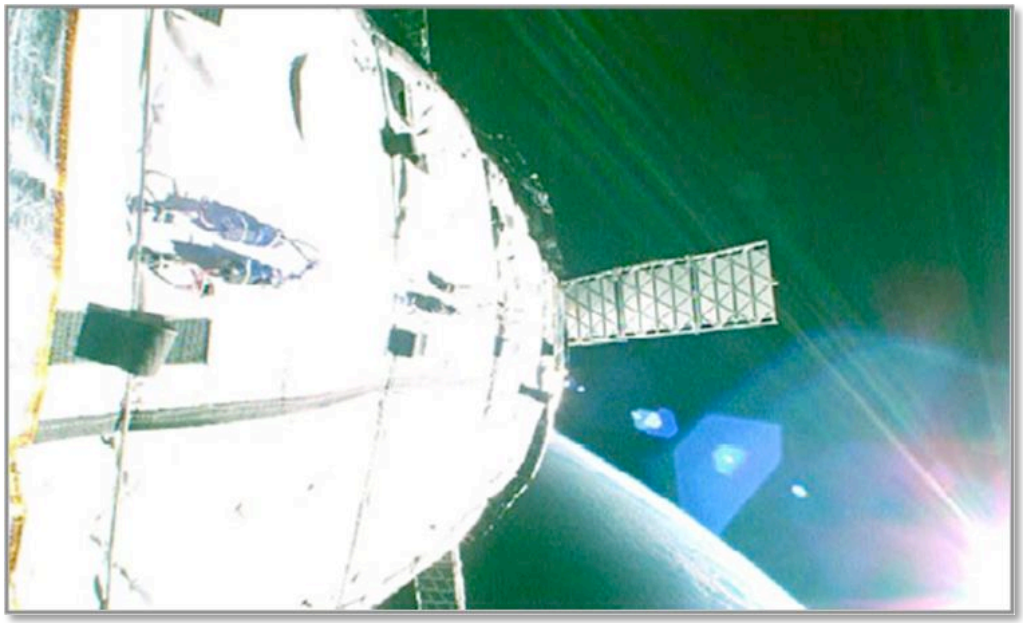
Groundwater Remediation

- To clean up an Apollo-era mess, Kennedy Space Center and the University of Central Florida partnered to develop a biodegradable environmental cleanup technology.
  - Emulsified Zero-Valent Iron (EZVI).
  - EZVI uses iron particles in an environmentally friendly oil and water base to neutralize toxic chemicals.
- Other partners in this effort include the U.S. DOE, DoD, EPA, GeoSyntec, Inc., and NASA's STTR Program.
- NASA's success in remediating this historic launch site has led to numerous non-exclusive licenses for EZVI.
- EZVI is now restoring contaminated sites to health in numerous states including Arkansas, California, Florida, North Carolina, and Texas.



Licensing and Partnerships Enable New Capabilities





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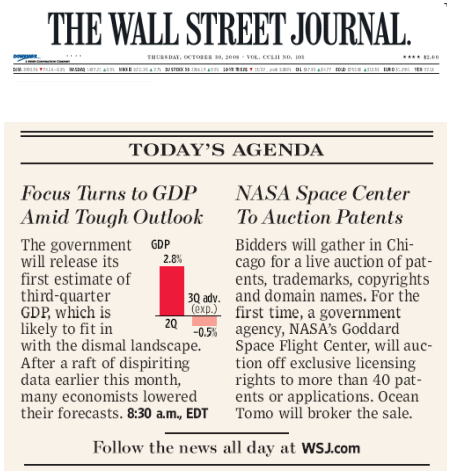
IP Auction – Benefits for All

NASA Goddard Space Flight Center granted an exclusive license to Ocean Tomo for a suite of more than 40 patented technologies. The company offered licenses for sale to bidders in a live IP auction in Chicago on October 30, 2008.

The and agreement between NASA and Ocean Tomo is a "Win" for everyone involved & first-ever auction of Gov't IP.

- NASA wins by leveraging Ocean Tomo's "infrastructure" and thereby optimizing the licensing opportunities for NASA technologies.
- As a small business, Ocean Tomo wins with the opportunity to expand the number of technologies available to execute its core business offering.
- Taxpayers win through an innovative process for utilization of NASA-developed technologies that advance the state of the art in many market sectors and may yield quality-of-life benefits.



THE WALL STREET JOURNAL.

TODAY'S AGENDA

Focus Turns to GDP Amid Tough Outlook

The government will release its first estimate of third-quarter GDP, which is likely to fit in with the dismal landscape. After a raft of dispiriting data earlier this month, many economists lowered their forecasts. **8:30 a.m., EDT**

GDP 2.8% 2Q 3Q adv. (exp.) -0.5%

NASA Space Center To Auction Patents

Bidders will gather in Chicago for a live auction of patents, trademarks, copyrights and domain names. For the first time, a government agency, NASA's Goddard Space Flight Center, will auction off exclusive licensing rights to more than 40 patents or applications. Ocean Tomo will broker the sale.

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Hilbert-Huang Transform

- An example of successfully brokering NASA technology through a no-cost brokerage partnership was the exclusive license for the Hilbert-Huang Transform, composed of 10 U.S. patents and one domestic patent application, which was part of a lot auctioned by Ocean Tomo Federal Services LLC, in October 2008.
- The agreement with DynaDx Corporation of Mountain View, Calif., licensed the Hilbert-Huang Transform, a NASA technology used to analyze nonlinear, nonstationary signals.
- The technology is being applied in the Multimodal Pressure-Flow (MMPF) technique for analysis of dynamic cerebral autoregulation—the ability of cerebral vessels to maintain a constant blood flow despite changes in arterial blood pressure.
- This capability, now available to the medical community, can help in the diagnosis and prediction of syndromes that affect the brain, such as stroke, dementia and traumatic brain injury.

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- Requirements
- Implementation
- Results & Successes
- ➢ **Initiatives & Opportunities**

No-Cost IP Brokerage Services

- On September 7, 2010, NASA issued an RFI for “No-Cost Intellectual Property Marketing and Brokerage Services with Revenue-Sharing Component upon License Execution.”
- NASA sought industry for input on what form these technology transaction services might take, including ideas such as public auctions, Internet-based agreements or other innovative concepts.
  - Partners would be compensated through a percentage of licensing revenues from any transaction they broker.
- This approach will add another tool to existing technology transfer efforts, allowing NASA to effectively move its technology into the marketplace.
  - Goals for the project include promoting transparency of NASA patent license transactions while enhancing development of commercial industry.
  - A primary benefit of partnering for no-cost brokerage services is the potential to make intellectual property licensing processes quicker and easier, saving time and resources for small companies that may have interest in NASA technologies and innovations.
- Responses are being reviewed currently and an RFP is anticipated to be released in FY 2011.

Additional Opportunities

- Licensing Best Practices.
  - Licensing Best Practices Group has been formed to discuss possible improvement in current practices that would lead to a greater number of licenses of NASA developed technologies.
  - Analysis is underway with recommendations being developed related to:
    - New Technology Report (NTR) process;
    - Outreach and marketing to identify/attract licensees;
    - License application and negotiation processes; and
    - License administration.
- Partnership Possibilities.
  - NASA is exploring other opportunities to help license NASA technology technology.
  - The Department of energy has provided limited NASA access to their Technology Portal, a website that allows users to browse energy-related patents for licensing opportunities at http://techportal.eere.energy.gov/.

National Aeronautics and Space Administration

www.nasa.gov

Backup

Federal Acquisition Regulation

- For NASA, FAR implements IP requirements for small entity contractors.
- Maintain appropriate follow-up procedures to ensure:
  - Subject inventions are identified and disclosed;
  - Inventions are elected or Government considers obtaining title;
  - Patent applications are filed; and
  - Government's rights are established and protected.
- Monitor and enforce contractor’s reporting and use of inventions.
  - Protect Public’s investment.
    - Ensure expeditious availability to the public.
  - Protect Government's interest.
    - Defend against claims and suits for patent infringement.
    - Avoid unnecessary payment of royalties.

Federal Acquisition Regulation

- NASA FAR Supplement applies to large business contractors.
  - Requires prompt reporting of inventions.
  - Benefits U.S. industry and general public.
    - Provides dissemination, utilization, development, and continued availability of NASA funded inventions.
  - Protects Government's interest.
- All NASA Contracts required to report new technology.
  - New Technology Reports (e.g. invention disclosures) provided directed to the New Technology Representative.
    - Generally Tech Transfer or Office of Patent Counsel personnel.
  - Title related documents submitted to the Patent Counsel.

Other Transactions Authority (OTA)

- 1958 Space Act is origin of NASA OTA
  - To enter "as may be necessary in the conduct of its work and on such terms as it may deem appropriate."
  - NASA OTA implemented through Space Act Agreements.
    - IP rights constrained by section 305(a).
  - OTA primarily used for unfunded Space Act Agreements.
  - OTA flexible, but not substitute for procurement.
    - Funded Space Act Agreements used sparingly.
- Section 305(a) limits IP flexibility.
  - Under 305(a) NASA is a title taking agency.
  - Invention made under NASA "305(j)" contracts are property of U.S. Gov.
  - But NASA can waive title subject to GPL.
- Administrative interpretation.
  - 305(a) applies to inventive work for NASA.
  - Determination that 305(a) does/does not apply is very fact dependent.

Additional Information

- **Technology Partnership Network**
  - http://www.nasa.gov/offices/ipp/network/index.html

- **Agency Lead IP Attorney**
  Gary G. Borda

  Tel: 202-358-2424
  Fax: 202-358-4341

- NASA Intellectual Property and Data Rights
  - http://www.nasa.gov/offices/ogc/ip/1210.html

- **Introduction**

- Spinoff Summary

- Examples

- Systems and Communication Tools

NASA Technology Transfer & Commercialization

- NASA has a long history of transferring technologies for public benefit.
- NASA's direction to do this traces to the Space Act that created NASA in 1958:

  "Provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

Applications of NASA-Derived Technology

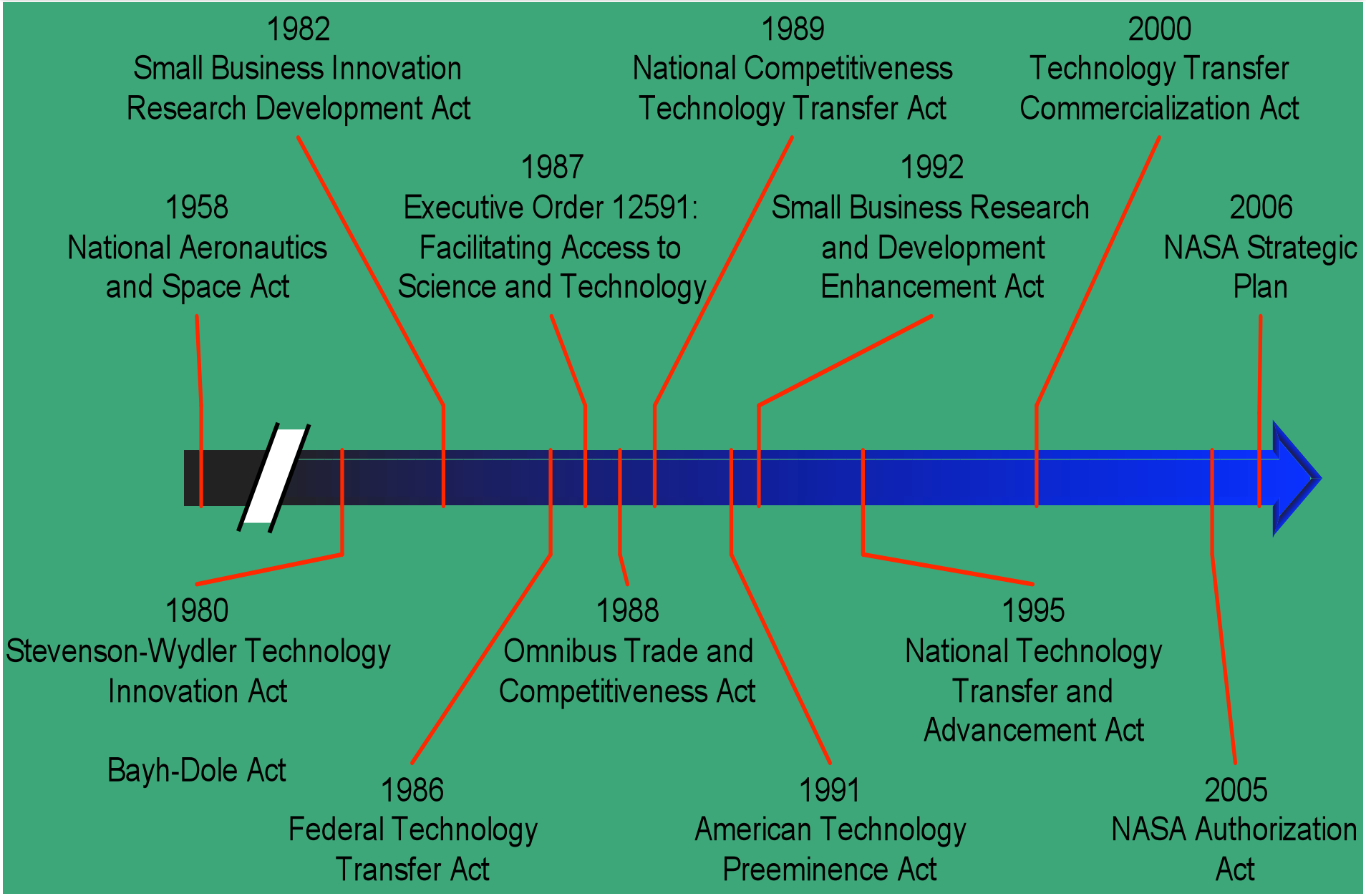
- Health and Medicine
- Transportation
- Public Safety
- Consumer, Home & Recreation
- Environmental and Agricultural Resources
- Computer Technology
- Industrial Productivity

NASA @ Home & NASA City
http://www.nasa.gov/city

Public Benefits of NASA-Derived Technology

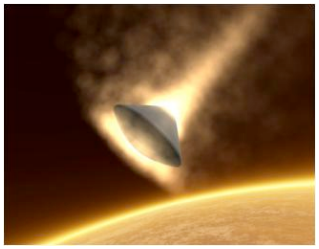
- Economic Growth
  - New Jobs
  - New Markets
  - Increased Efficiency
  - Improved Competitiveness
- Quality of Life
  - Improved Safety
  - New Products
  - Lives Saved or Extended
  - Green Technologies
  - Environmental Cleanup

Policy Guidance and Statutory Authority



OCT Offers Numerous Benefits to Potential Partners

- Funding or Leveraged Resources through partnerships:
  - Early Stage Innovation.
  - Game-changing Technology.
  - Cross-cutting Demonstrations.
- Technology and Software.
  - Access through licensing or other partnerships.
- Test and Demonstration Facilities/Capabilities.
  - Access to NASA's facilities through partnerships.
  - Access to the space environment through flight opportunities.
- Expertise.
  - Access to NASA's technical expertise through partnerships.
- Facilitation to proactively seek and enable partnerships.



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➢ **Spinoff Summary**

- Examples

- Systems and Communication Tools

Spinoff

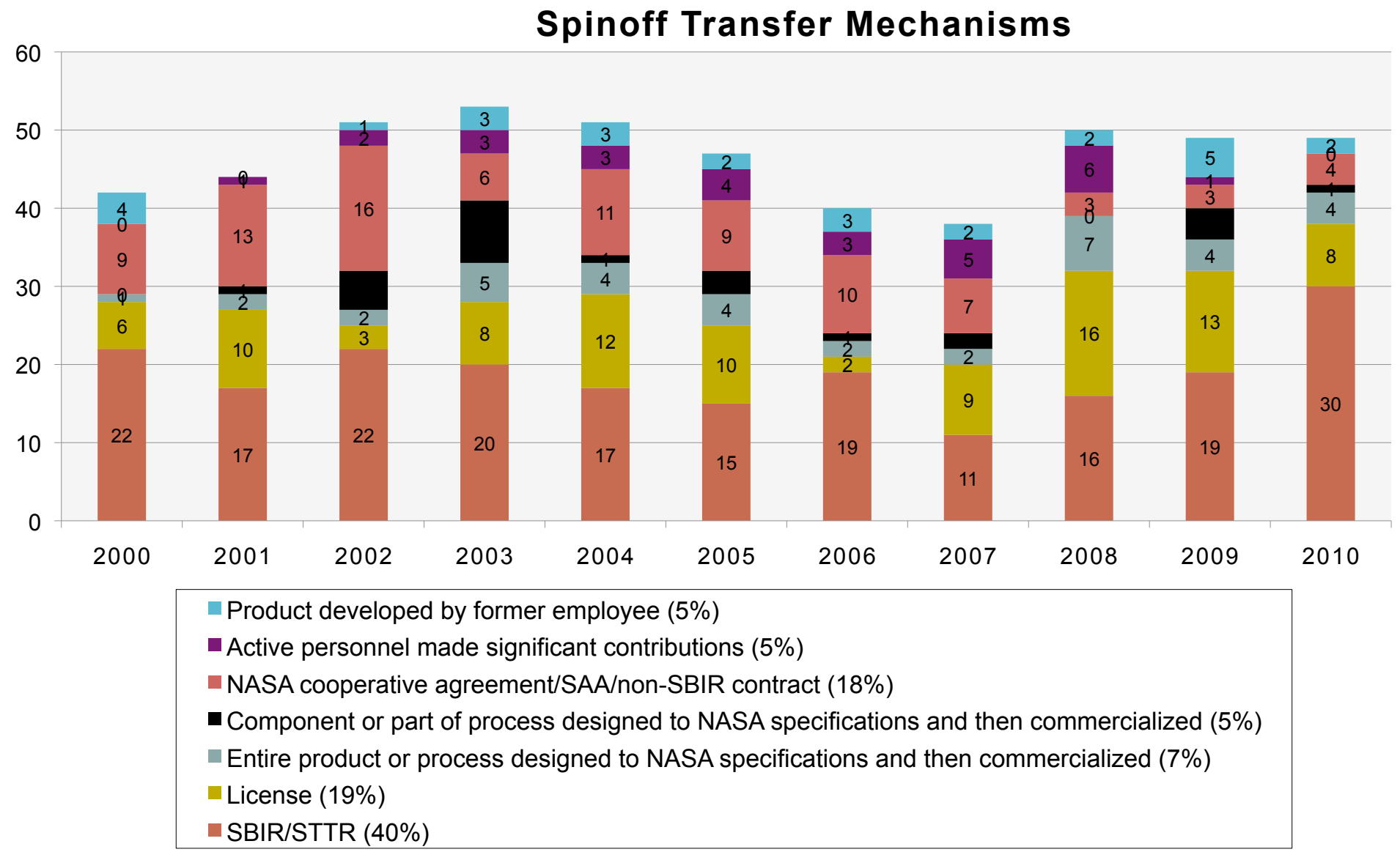
Spinoff (spin´ôf´) -*noun*.

1. A commercialized product incorporating NASA technology or “know how” which benefits the public. Qualifying technologies include:
   - Products or processes designed for NASA use, to NASA specifications, and then commercialized.
   - Components or processes involving NASA technology incorporated into a commercial product, employed in the manufacturing of a product, or used to modify the design of an existing product.
   - Products or processes to which NASA laboratory personnel made significant contributions, including the use of NASA facilities for testing purposes.
   - Successful entrepreneurial endeavors by ex-NASA employees whose technical expertise was developed while employed by NASA.
   - Products or processes commercialized as the result of a NASA patent license or waiver.
   - Commercial products or processes developed as a result of the Small Business Innovation Research or Small Business Technology Transfer programs.
2. NASA’s premier annual publication, featuring successfully commercialized NASA technologies.

Spinoff

- NASA features some of the best examples of commercialized technology in its annual *Spinoff* publication.
- The benefits of commercialized NASA technology penetrate our national economy as well as markets around the globe, by contributing to development of services and technologies in the fields of health and medicine, transportation, public safety, consumer goods, environmental resources, computer technology, and industry.
- Each year since 1976, a new issue of *Spinoff* has highlighted 40-50 of the best NASA technology transfer successes from the prior year.
- *Spinoff* is available in its original print form, online through a dedicated Web site at http://spinoff.nasa.gov, and as an interactive CD-ROM.
- NASA also maintains a benefits database where nearly 1,700 Spinoff stories are now available online in a searchable format at http://www.sti.nasa.gov/spinoff/database.

Sources of Spinoffs



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Bloom Energy: Breakthrough Fuel Cell Technology

Bloomenergy™

- Bloom Energy traces its roots to work performed at the University of Arizona as part of the NASA Mars space program.
  - Dr. KR Sridhar and his team were charged with creating a technology that could sustain life on Mars.
  - They built a device capable of producing air and fuel from electricity, and/or electricity from air and fuel.
- Bloom Energy reports that its NRP location has provided many benefits including:
  - Ability to maintain and build close relationships with senior NASA staff, opening the door for continued collaborative partnerships;
  - Proximity to the scientific, engineering, and business talent in the center of Silicon Valley;
  - Access to networks of entrepreneurial companies and venture capitalists;
- Since its founding in 2002 with a small technical team, Bloom Energy has grown to a workforce of over 700 people.

NASA Research Park at Ames Research Center

NASA Research Park: 2020 Campus Plan

NRP Collaborations Yield Entrepreneurial Partnerships & Innovation

- NASA Research Park is uniquely positioned in the heart of Silicon Valley as a nourishing and dynamic environment for cutting-edge research and education.
- Through this NRP initiative, NASA Ames is creating:
  - A world-class shared-use R&D and education campus for industry, academia, non-profits, and government;
  - A center for innovation and entrepreneurship;
  - A unique community of scientists, engineers, students and educators with a shared mission.
- NRP provides a two-direction partnerships
  - Traditional NASA technology commercialization “out” to industry, and
  - Technology infusion “into” NASA by gaining access to knowledge and leading-edge technology from the external community

Partnerships for Economic Growth

- NASA is pursuing economic growth through research parks and partnerships that can catalyze technology transfer and innovation.
- KSC broke ground on a research park in July 2010.
- NASA recently partnered via a Space Act Agreement with the Colorado Association of Manufacturing and Technology (CAMT).
  - CAMT's goal is to develop a pilot initiative focused on accelerating technology transfer and commercialization through the creation of a regional Technology Acceleration Park (TAP), focused on the Aerospace and Energy sectors.
  - Other partners include: NREL, Department of Commerce, ITA, Department of Labor, University of Colorado, Colorado State Department of Economic Development, Jefferson Country Workforce Development Council, Colorado STEM Network, Governor's Office.
- This model for leveraging Federal investments in R&D to help accelerate economic growth reflects successful public-private partnerships like the NASA Research Park at NASA's Ames Research Center.
- NASA plans to replicate these models in other states and regions as well, to drive regional economic growth and strengthen aerospace and energy supply chains.

Centennial Challenges Highlights

Masten Space Systems and Armadillo Aerospace win Lunar Lander Challenge and as Space Entrepreneurs are honored as the "Persons of the Year"

Paul's Robotics, a student team beats 22 others to win $500,000 in the Regolith Excavation Challenge

Ted Sothern and Peter Homer display their prize winning Astronaut Gloves

LaserMotive climbs to one kilometer with beamed power to win $900,000

Commercial Reusable Suborbital Research (CRuSR)

Virgin Galactic

Blue Origin

XCOR Aerospace

Armadillo Aerospace

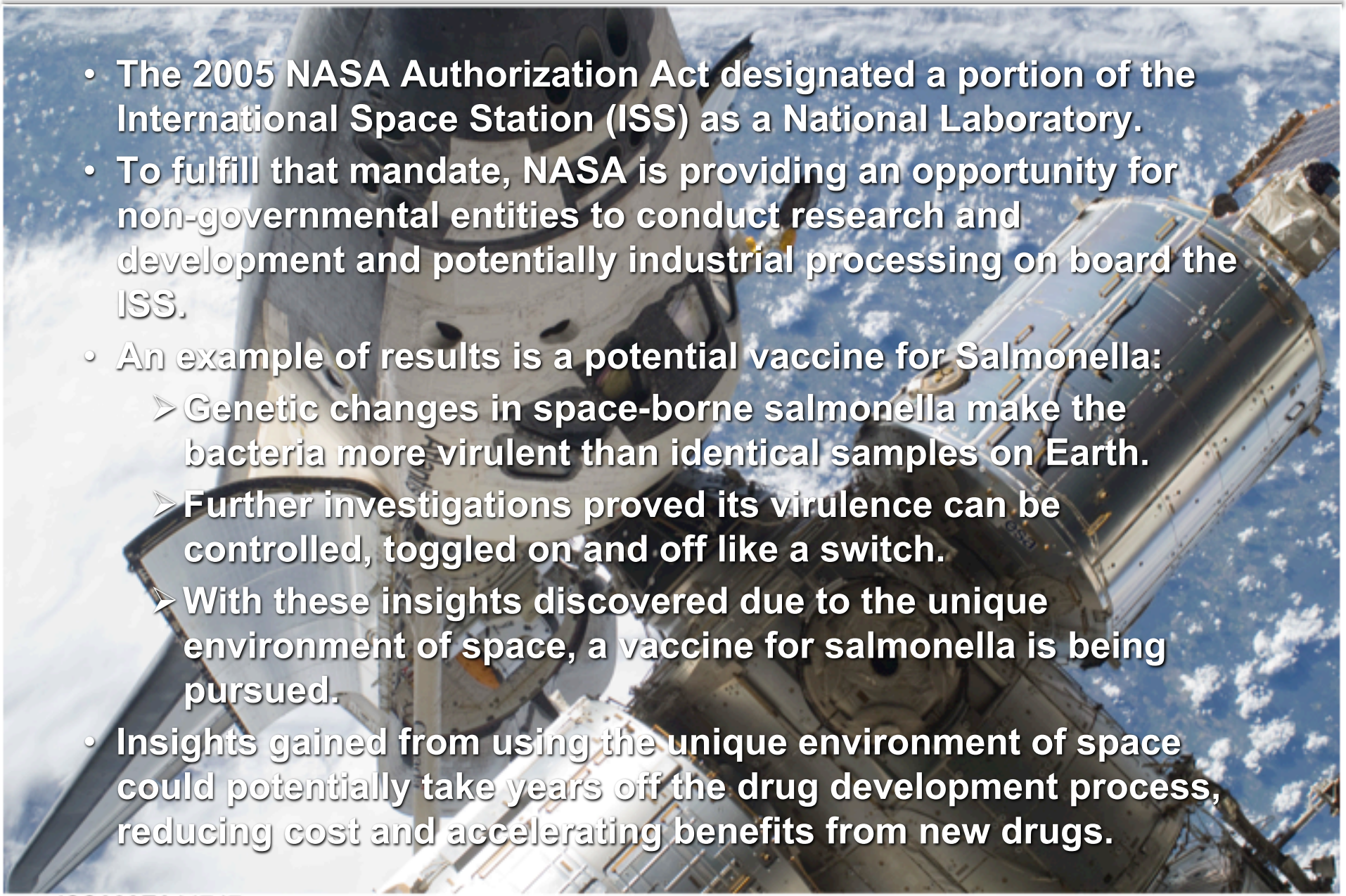
(Just received CRuSR award)

Masten Space Systems

(Just received CRuSR award)

- Many approaches (horizontal & vertical take-off and landing)
- Significant private investment
- Designing for high flight rates & low cost operability
- Microgravity, pressurized, temperature-controlled payload environment

Partnerships in Space Research



- The 2005 NASA Authorization Act designated a portion of the International Space Station (ISS) as a National Laboratory.
- To fulfill that mandate, NASA is providing an opportunity for non-governmental entities to conduct research and development and potentially industrial processing on board the ISS.
- An example of results is a potential vaccine for Salmonella:
  - Genetic changes in space-borne salmonella make the bacteria more virulent than identical samples on Earth.
  - Further investigations proved its virulence can be controlled, toggled on and off like a switch.
  - With these insights discovered due to the unique environment of space, a vaccine for salmonella is being pursued.
- Insights gained from using the unique environment of space could potentially take years off the drug development process, reducing cost and accelerating benefits from new drugs.

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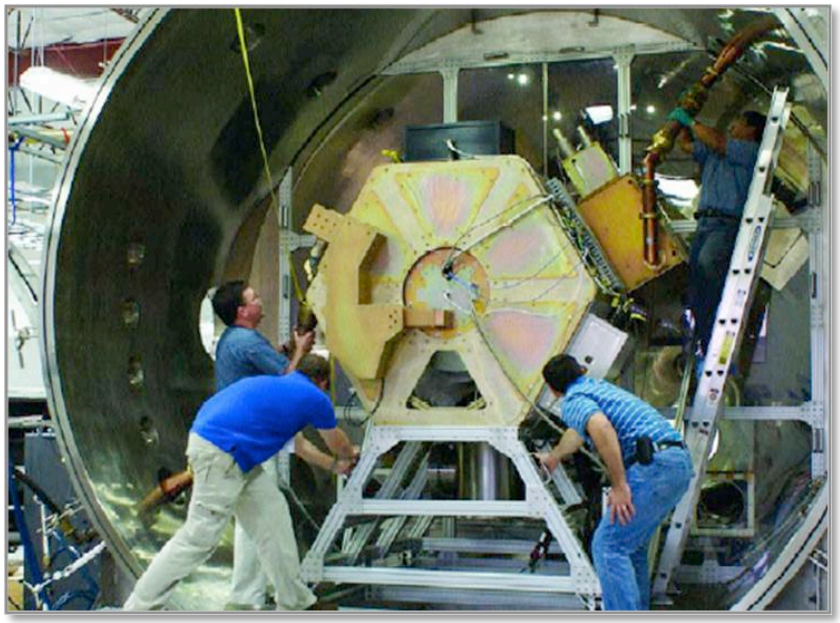
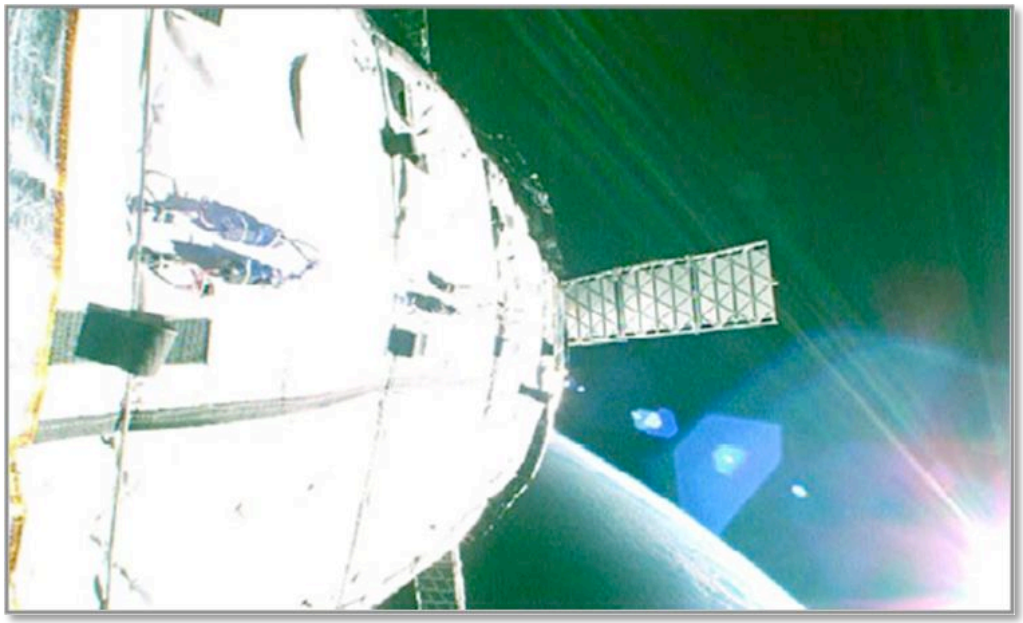
Licensing and Partnerships Enable New Capabilities





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TecFusion Summits

- 28 TecFusion™ Summits since 2004.
- Large companies have reviewed over 3,700 Phase II technologies.
- 335 SBIR companies have presented over 400 technologies.
- 21 sponsors.
  - 2 have sponsored 3 Summits.
  - 3 sponsored 2 Summits.
  - Some annually and in other cases every year-and-a-half to 2 years.
  - Two are on the schedule for a fourth Summit.
  - 12 Fortune 500 companies.
- 65 technologies ongoing discussions with 9 in continuing partnering efforts.

NASA Technologies Helping Sustainability

- Assistance to Developing Countries
  - Clean Drinking Water
  - Improved Agriculture
  - Telemedicine and wireless networks
  - Improved Environmental Decision Making
- Environmental Cleanup
  - Groundwater Remediation
  - Land Mine Cleanup
  - Landfill Cleanup
  - Oil Spill Cleanup

- Use of Green Technologies
  - Aeronautics Technologies
  - Green Buildings
  - Encouraging Green Technologies
  - Solar Power Applications
  - Paint Stripping
  - Global Research into Energy and the Environment at NASA (GREEN)
- Disaster Warning and Relief
  - Earthquake relief
  - Tsunami Warning
  - Wildfire Response
  - Hurricane Warning

NASA-derived technologies are saving lives and improving the quality of life across the country and around the globe.

NASA-Derived Technologies Contributing to Security

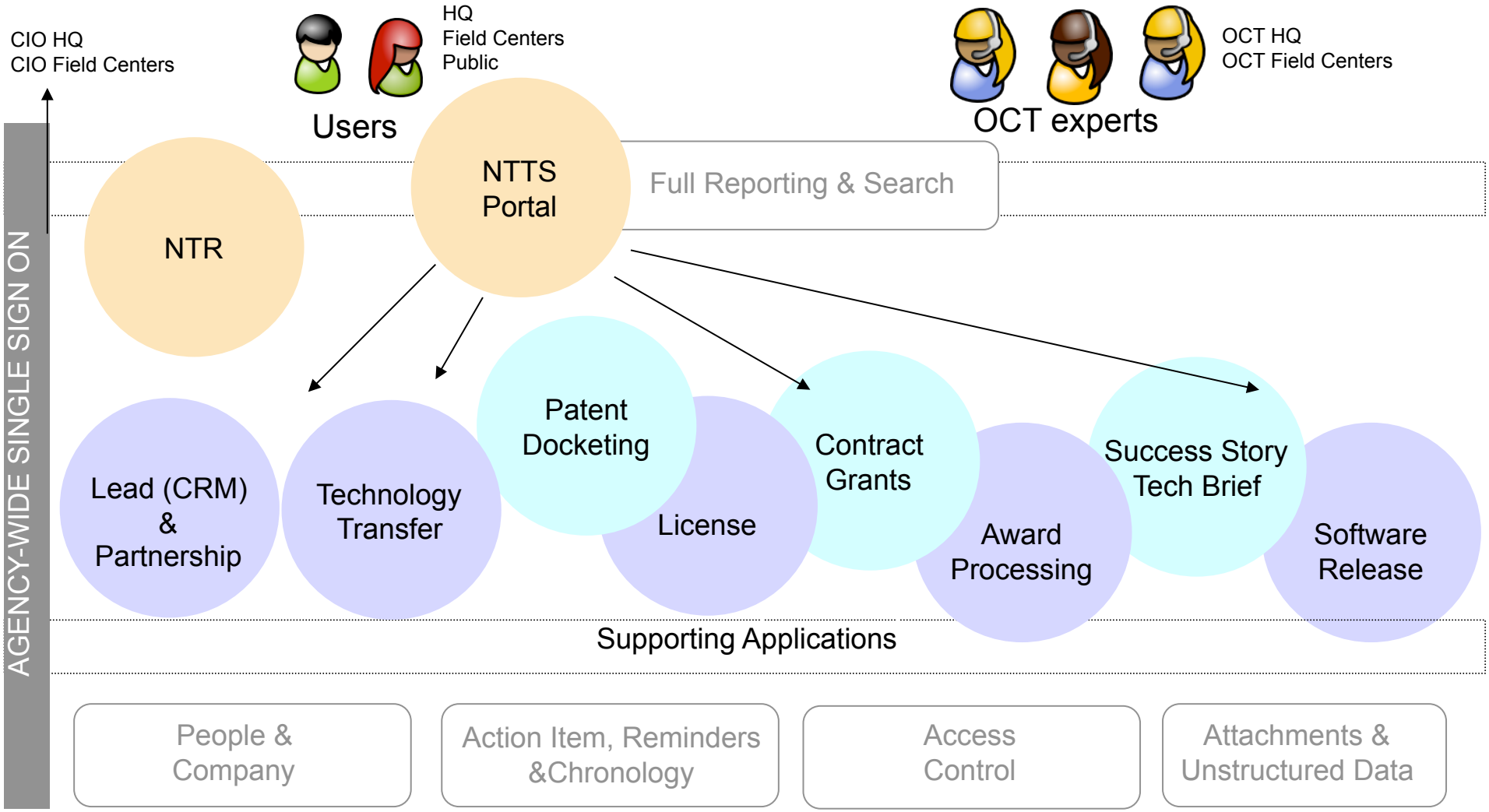
- Improving Operational Systems
  - Health & Performance Monitoring for Aviation Security
  - Safe Composite Over-wrap Pressure Vessels
  - Fire-Protective Fabrics & Smoke Masks
  - Intumescent Materials
  - Neutralizing Land Mines
  - Secure Networks for First Responders and Military
- Threat Detection
  - Detection/Warning of Chem/Bio Attack
  - Hyperspectral Imaging for Counter-Terrorism
  - Anthrax Smoke Detectors
  - Fiber Optic Chemical Agent Sensing
- Inspection Technologies
  - Crack Detection in Nuclear Power Systems
  - Hyperspectral Imaging for Food Safety
  - Inspection of Suspicious Liquid/Solid Substances
- Identification & Investigation
  - Pattern Recognition for Security Applications
  - Video Enhancement Supporting Criminal Investigations

These examples represent how NASA-derived technologies are being put to work and making the world a safer and more secure place.

- Introduction
- Spinoff Summary
- Examples

➢**Systems and Communication Tools**

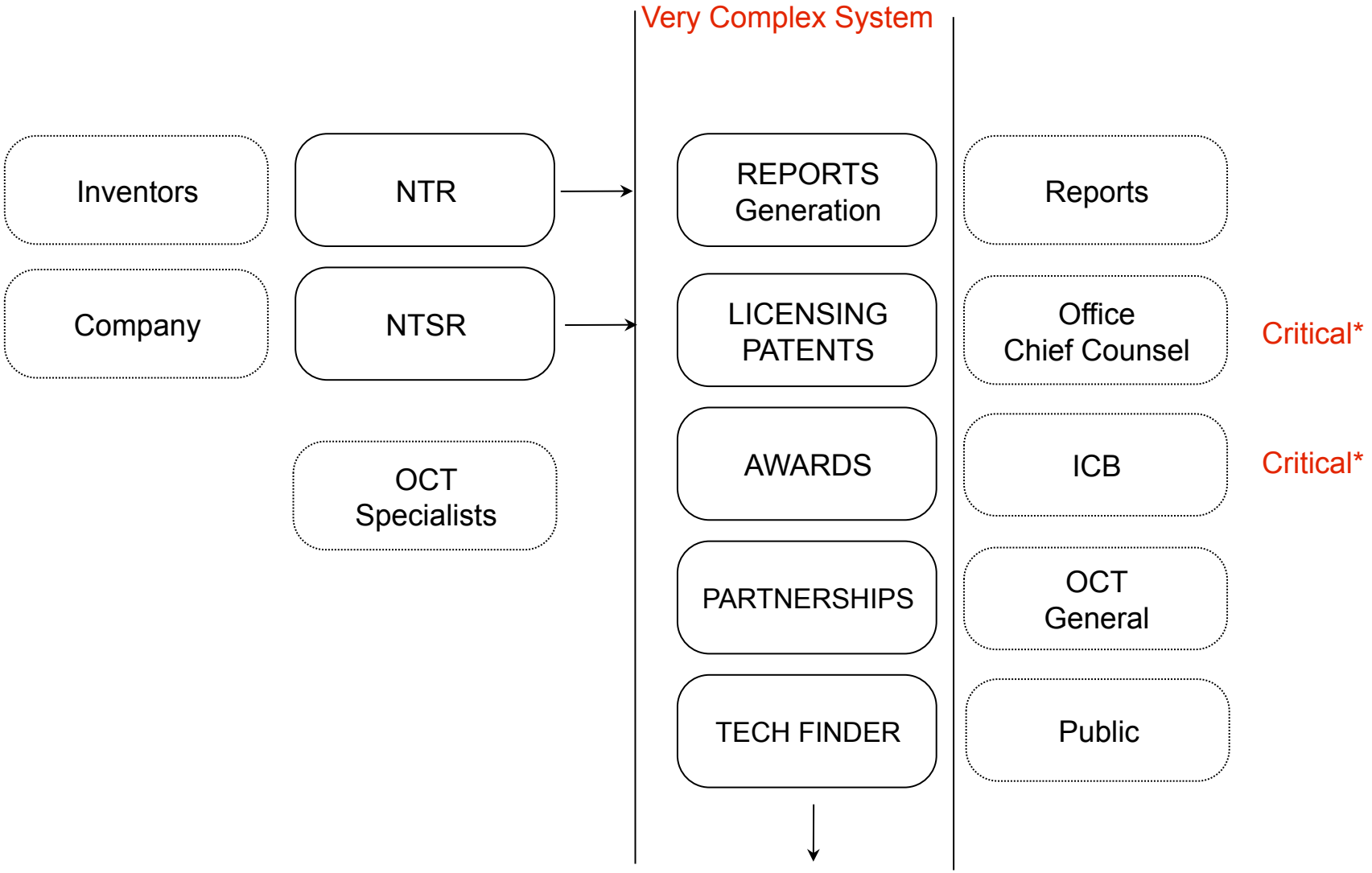
NASA Technology Transfer System (NTTS)



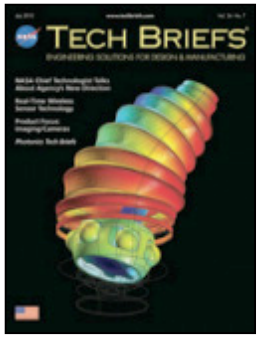

NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION
NASA TECHNOLOGY
TRANSFER SYSTEM
Add / Remove Modules
Logged in as: demo-arc demo-arc [arc/demo]
Home | User Account | Access Control | Help | Logout
Reports
These tools gives the IPP community access to many reports on NTTS data.
+ Continue to IPP Metrics
+ Continue to Reports
+ Search NTTS
Communications
Collection of success stories reported by the firm based on technology developed under NASA.
+ Continue to Success Story
+ Continue to Tech Brief
Technology
This tool helps NASA employees and parties under NASA funding agreements to report new technology information.
+ Continue to NTR View
+ Continue to Tech Transfer View
Patent
The Patent Docketing system makes inventions available to industry through its Patent Licensing Program.
+ Continue
Partnership
Captures and tracks all partnership types and the associated investment by both NASA and its partners.
+ Continue
Contract Grant
This is the tool to manage the process for contracts and grants.
+ Continue
Licensing
This tool helps NASA inventors in protecting their technology, and in the licensing of that technology to existing companies.
+ Continue
New Technology Summary Report
NASA contracts, grants, cooperative agreements, and subcontracts (Funding Agreements) for experimental, developmental or research work require each Contractor/Grantee/Subcontractor (C/G/S) to report New Technology Items to NASA.
+ Continue
Awards Processing
This tool helps manage the awards process between IPP and the Office of the Chief Engineer.
+ Continue
NASA Privacy Statement, Disclaimer, and Accessibility Certification
NASA Official: David Maluf
Curator: NTTS Web Group

NASA Technology Transfer System (NTTS)

NTTS Data and Information Flow (Dominant)

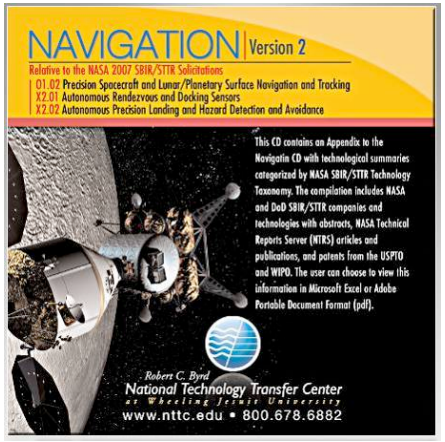


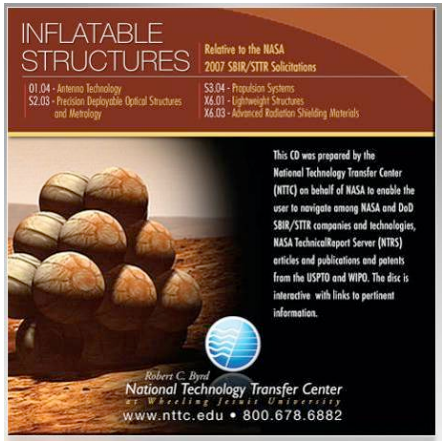
Finding Technologies



- NASA TechBriefs publishes new technologies in print and online.
- NASA technologies are searchable on many databases, including technology.nasa.gov.

- Working with the National Technology Transfer Center (NTTC) we are generating focused technology databases.
- As part of OpenGov, NASA established an RSS feed with technologies.

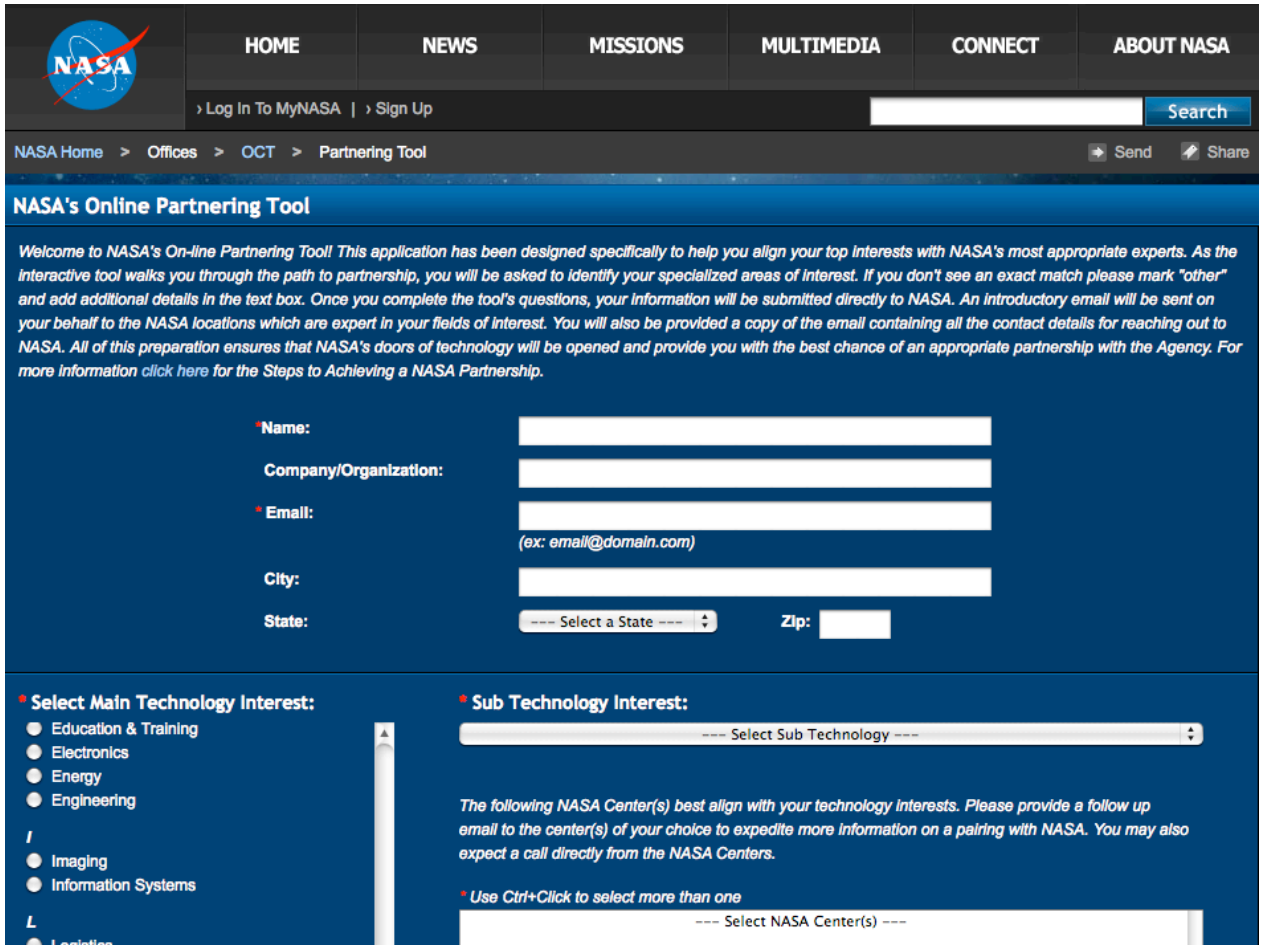




http://www.sbipp.com/technologyportfolios/technology_list.asp

How to Partner with NASA

- http://www.nasa.gov/offices/oct/partnership/how_to_partner/index.html
- http://octpartneringtool.nasa.gov/oct/



NASA Communication Tools

- **Publications**

- **Internet**

- **Events**

- **Competitions**

National Aeronautics and Space Administration

www.nasa.gov

Backup

Entrepreneurship & Innovation

- A goal of the innovation strategy for the U.S., released by the National Economic Council and the Office of Science and Technology Policy, is to:

  "Encourage high-growth and innovation-based entrepreneurship."

- The white paper outlining the strategy states that:

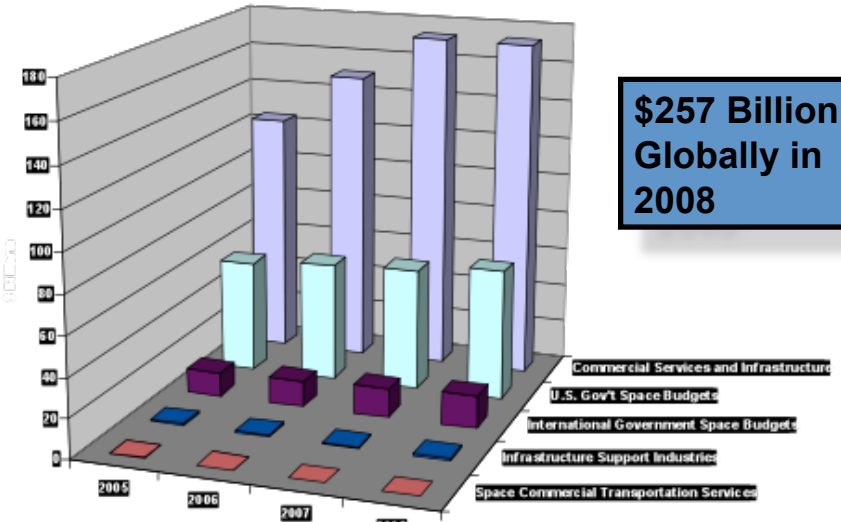
  "Entrepreneurship has played, and will continue to play, an essential role in generating innovation and stimulating U.S. economic growth."

- NASA is a Critical Component of America's Innovation Engine.
  - As a research and development agency, NASA plays a vital role in America's innovation engine and, as such, its future economic prosperity and security.
  - An enhanced technology and innovation focus at NASA responds to the recommendations of multiple external stakeholders.
  - NASA's new Space Technology investments will create a more vital and productive aerospace industry and address broader national needs, such as energy, health and wellness, and national security.
- NASA's Office of the Chief Technologist (OCT) offers entrepreneurs a wide variety of engagement opportunities and tools.

A Strategy for American Innovation: Driving Towards Sustainable Growth and Quality Jobs; Executive Office of the President, National Economic Council, Office of Science and Technology Policy; September 2009

How Does Space Stimulate Economic Growth?

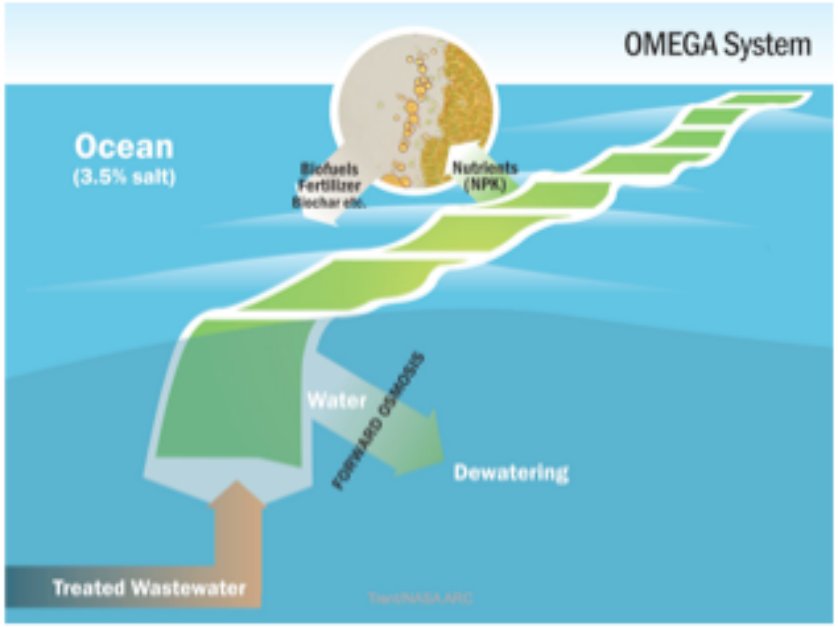
- Activity directly related to space products and services.
  - Satellites, launch vehicles, ground systems.
  - $257 billion in 2008.
- New capabilities, businesses, products and services derived from space technologies.
  - Spinoffs from the space program.
  - More than 1,700 documented from NASA alone.
- Productivity enhancements and quality of life improvements from the above, such as:
  - Efficient tracking and positioning using GPS.
  - Improved health from telemedicine, enriched baby food and other medical advancing spinoffs.

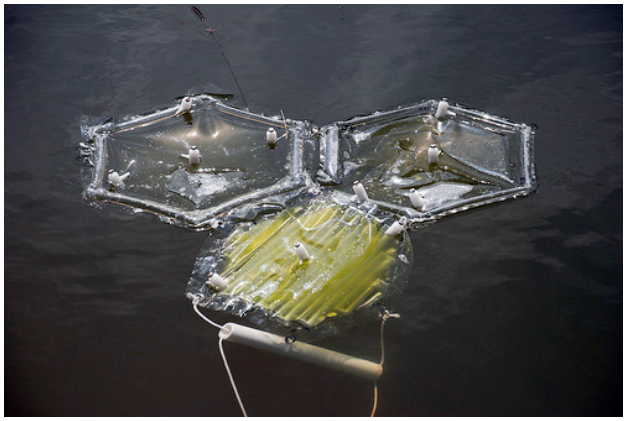


$257 Billion Globally in 2008

From the Space Report 2009, Space Foundation

OMEGA: Algae Bioreactor as a Sustainable Energy Source





Plastic bags with semi-permeable forward-osmosis membranes allow fresh water to flow out into the ocean, while retaining the algae and nutrients.

- When astronauts go into space, they must bring everything they need to survive.
  - Living quarters on a spaceship require careful planning and management of limited resources, which is what inspired the project called “Sustainable Energy for Spaceship Earth.”
  - It is a process that produces "clean energy" biofuels very efficiently and very resourcefully.
- The Algae OMEGA project (Offshore Membrane Enclosure for Growing Algae) is meant to provide:
  - Significant quantities of sustainable, carbon-neutral biofuels, as well as food, fertilizer, and other useful products, while treating wastewater and sequestering carbon dioxide.
  - It provides these products and services without competing with agriculture for land, fertilizer or freshwater.
- Supported by NASA Aeronautics Research Mission Directorate and the California Energy Commission.

Benefits of Prize Competitions & Challenges

- **Stimulate innovation in ways unlike contracts or grants**
  - Reward achievement, not effort
- **Reach new sources of innovation, new talent**
  - Multiple teams & multiple approaches to same problem
- **Stimulate new commercial ventures**
  - New startups, new partners, more commercial competition
- **Achieve returns that outweigh investment**
  - High ratio of private investment to prize value
  - Almost all funds go to prize purses
- **Educate, inspire and motivate the public**
  - Train the future workforce
  - Increase awareness of science & engineering
  - Inclusion, not exclusion

Model for Government-sponsored Prizes

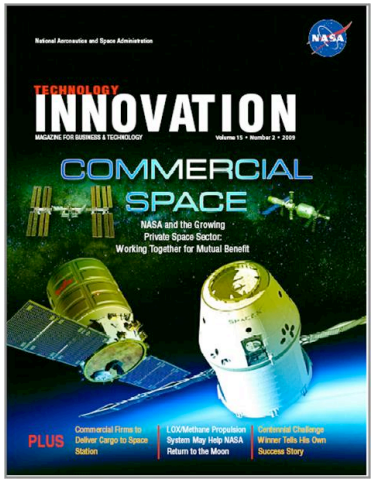
Photo: New York Times

"NASA's Centennial Challenges have triggered an outpouring of creative solutions from students, citizen inventors, and entrepreneurial firms for technologies such as lunar landers, space elevators, fuel-efficient aircraft, and astronaut gloves."

Memo to all Executive Departments and Agencies from Office of Management & Budget
Guidance on the Use of Challenges and Prizes to Promote Open Government,
March 8, 2010

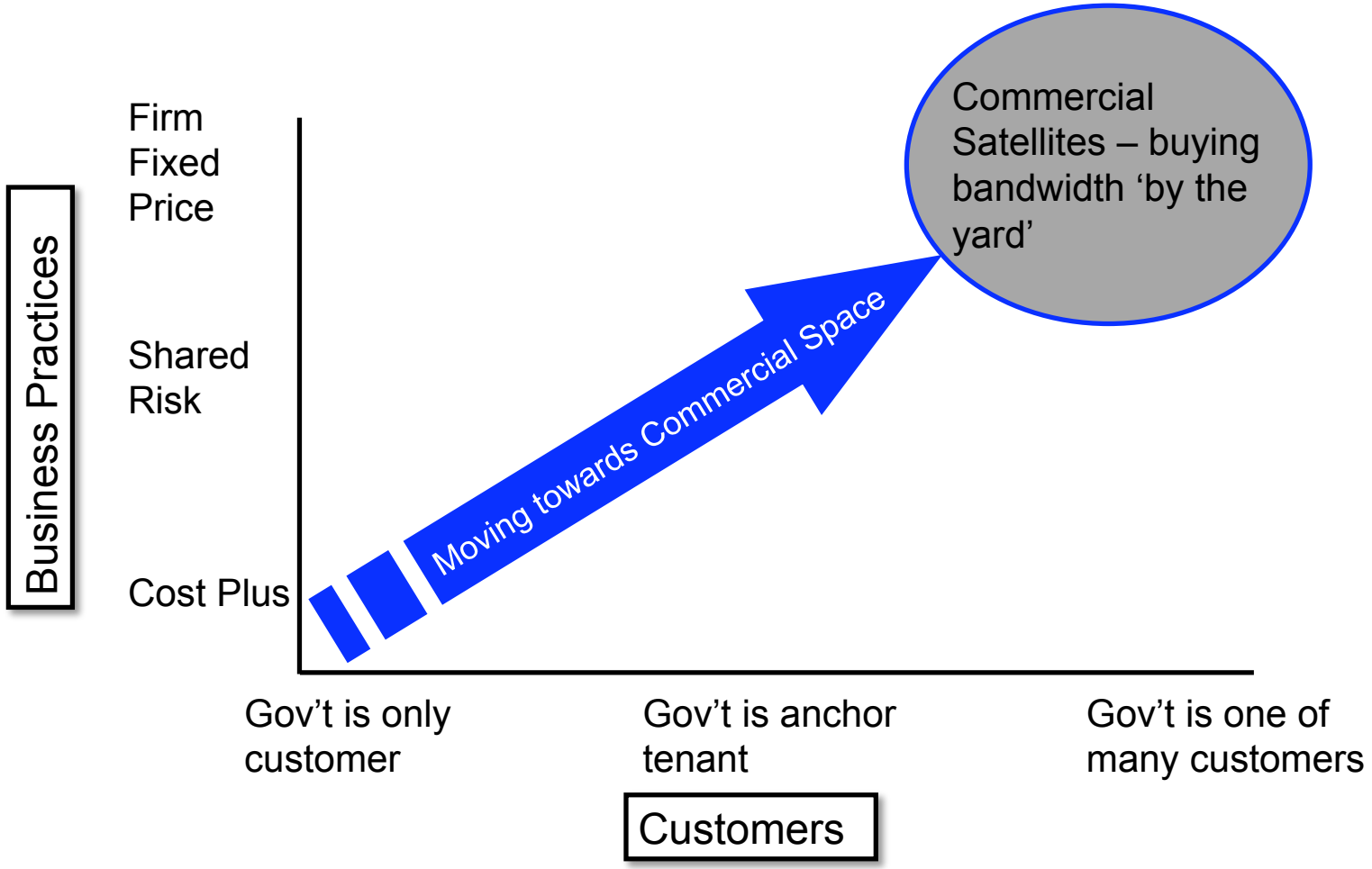
Commercial Space and NASA

- **New National Space Policy**: A robust and competitive commercial space sector is vital to continued progress in space.
- Three key themes underscore some of the changes already underway in how NASA is engaging the commercial space community:
  - Private sector relationship as partner rather than contractor.
  - Government purchase of services rather than hardware.
  - Creating more opportunities and broader reach for innovation.
- Using a NACA approach focuses on building an industry, not a program.
- For NASA today, this implies seeking the Wright Brothers of 21st Century through open innovation and focusing on the foundational research and technology required to foster commercial space markets.



What is Commercial Space?

- No single discrete definition, but rather a context for understanding different aspects of what makes something a ‘commercial space’ activity.



Summary of NASA Commercial Space Activities

COMMERCIAL SPACE Accomplishments

Accomplishments to date have met and exceeded the 2006 Commercial Space Plan

ESMD

- SpaceX completes all milestones for COTS Phase 1 and delivers Falcon 9 to KSC
- Orbital Sciences completes Cargo Module PDR

- ESMD and IPP Seed Fund support includes lunar drilling robotics and oxygen from simulated lunar regolith

SOMD

- Signs firm-fixed-price multi-billion-dollar contracts for commercial resupply services (CRS for space station)
- ISS National Lab MOUs with NIH and USDA, including biotech and other commercial ISS payloads

- Commercial water production services contract for ISS signed with Hamilton Sundstrand that will be using a Sabatier-based reactor system
- Contract with Zero-G for aircraft parabolic flight services

SMD

- Earth science activities involving commercial remote sensing
- NASA Lunar Science Institute established, including commercial ISRU initiatives
- Spin-off of advanced optics and detectors to industry

ARMD

- Research on broad spectrum of fundamental technologies (e.g. materials, computation fluid dynamics, vehicle health maintenance) with possible applicability to commercial space

- Research on technologies relevant to launch and return of reusable spacecraft

IPP + OTHER

- SBIR and STTR efforts including docking sensors, power systems, avionics and others
- IPP work with NASA Mission Directorates on Seed Fund projects for Inflatable Lunar Habitat, Li-Ion Battery and others
- Peter Horner wins $200K Astronaut Glove Challenge

- IPP Seed Fund support of lunar habitat development including inflatable technologies

- Armadillo Aerospace wins $350,000 Level 1 prize of Lunar Lander Challenge
- FAST sponsors technology development for several SBIR companies in a simulated space environment on parabolic aircraft flights

- KSC commercial launch site, and SpaceX Falcon 9 at KSC; work on launch pad at Complex 40

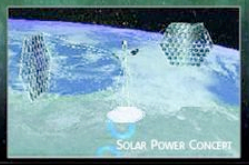
Current and Planned Near Term Activities

ESMD

- New commercial initiatives include Low Impact Docking System and development of lunar surface systems
- Studying feasibility of using suborbital missions for microgravity research including life & physical sciences & technology development
- Stimulate commercial human spaceflight capabilities

SOMD

- ISS serving as engineering testbed for future commercial communication technologies, including recent testing of Delay Tolerant Networking (DTN) to enable ISS to serve as an Internet node for cloud computing on-orbit
- Currently testing sub-systems demonstrations for solar-electric power conversion that have ground-based and space-based applications



SMD

- Work continues on international science and commercial partnering, such as NLSI agreements with Korea, Canada and the United Kingdom
- Use of commercial remote sensing satellites for Earth science

ARMD

- Evaluation of re-entry technologies, including those that support reusable applications

IPP + OTHER

- Centennial Challenges prizes advancing innovation and technology needed for commercial space
- IPP Seed Funding work with NASA Mission Directorate involving universities, private sector and other agencies, and SBIR/STTR efforts related to commercial space

- FAST will use commercial suborbital services as they become available
- Development of Wallops Flight Facility Mid-Atlantic Regional Spaceport (MARS) for commercial launch such as COTS-Orbital Sciences *Taurus II*

Future Activities

ESMD

- Applying the COTS model to new areas consistent with ESMD commercial space policy
- Lunar, Mars, NEOs/Asteroid, and other exploration with commercial space partnering
- Space tourism complementing exploration
- Space resource commercialization, such as ISRU and/or space solar power for lunar applications

SOMD

- Commercial LEO and lunar habitats complementing NASA missions
- On-orbit satellite servicing, space debris management, on-orbit fuel depots and other commercial space operations services

SMD

- Remote sensing instruments as secondary payloads on commercial systems
- Partnerships on instruments and technology development, or small science investigations
- Enabling commercial space weather information products, such as warning to communications systems operators

ARMD

- Further development of technologies to facilitate reusable access to space
- Research for point-to-point suborbital flight including commercial global flight projects such as DOD Small Unit Space Transport Insertion (SUSTAIN)

IPP + OTHER

- IPP programs supporting commercial LEO and lunar resource utilization such as lunar regolith programs, space solar power for lunar operations, micro-gravity and others; Earth viewing/global monitoring initiatives

- Commercial space partnerships with U.S.and/or international entrepreneurs, including work complementing Spaceport America in New Mexico

Key to Abbreviations: **ATC** Air Traffic Control **ARMD** Aeronautics Research Mission Directorate **COTS** Commercial Orbital Transportation Services **DOD** Department of Defense **ESMD** Exploration Systems Mission Directorate **EVA** Extra Vehicular Activity **FAA** Federal Aviation Administration **FAST** Facilitated Access to the Space Environment for Technology Development and Training **IPP** Innovative Partnerships Program **ISS** International Space Station **LEO** Low-Earth Orbit **MOU** Memorandum of Understanding **NEO** Near-Earth Object **NIH** National Institutes of Health **NLSI** NASA Lunar Science Institute **NRA** NASA Research Announcement **OSC** Orbital Sciences Corporation **PDR** Preliminary Design Report **RFI** Request for Information **SBIR** Small Business Innovative Research **SMD** Science Mission Directorate **SOMD** Space Operations Mission Directorate **STTR** Small Business Technology Transfer

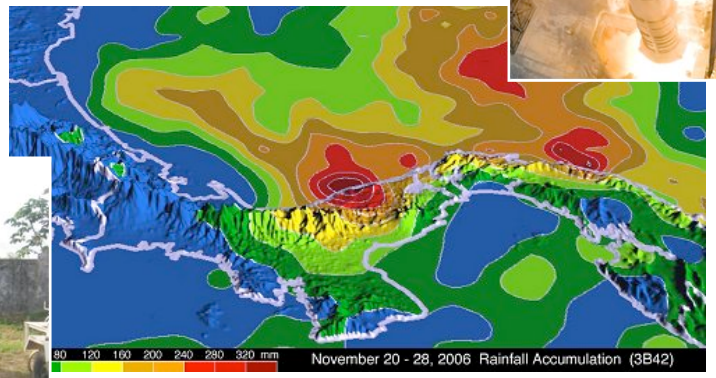
Partnerships in On-Line Gaming

- NASA has entered into a Space Act Agreement with the Virtual Heroes Inc. and Project Whitecard Inc., whose joint proposal was selected for creation of a NASA Massively Multi-player Online Game (MMOG).
- The game is being developed via a partnership, at no cost to NASA.

- Virtual Heroes created the America's Army MMOG for the US Army, and is located in Research Triangle Park, NC.
- Project Whitecard is a Canadian company with over ten years of experience in implementing national online web applications.
- This project has the goal of increasing interest in STEM careers among US high school and college students.

NASA Technology: For the Benefit of all Mankind

- **NASA technologies are being used across the planet and for the benefit of the developing world in important areas:**
  - **Clean Drinking Water**
  - **Improved Agriculture and Food Distribution**
  - **Telemedicine and Wireless Networks**
  - **Environmental Monitoring and Management**
  - **Disaster Warning and Relief**
  - **Educational Resources**
  - **Energy Storage**
  - **Hazard Reduction**



Launch Partnership for Accelerating Innovation

LAUNCH
ACCELERATING INNOVATION FOR A SUSTAINABLE FUTURE.

LAUNCH
WATER

- LAUNCH identifies and supports innovative work poised to contribute to sustainability of life on planet Earth.
  - LAUNCH is convened by NASA in partnership with USAID, Department of State, and private entities.
  - LAUNCH leverages the collective expertise, networks and influence of a diverse community of leaders.
- The inaugural event, LAUNCH: Water occurred on March 16-18, 2010 at NASA's Kennedy Space Center.
- The second event, LAUNCH: Health occurred on October 30-November 1 at NASA's Kennedy Space Center.